

## 11.0 RADIOACTIVE WASTE MANAGEMENT

The radioactive waste management systems (RWMS) are designed to control, collect, handle, process, store, and dispose of liquid, gaseous, and solid wastes that may contain radioactive materials. The systems include the instrumentation used to monitor and control the release of radioactive effluents and wastes and are designed for both normal operations (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; inservice inspection; and calibration) and anticipated operational occurrences (AOOs) (activities such as loss of power to all recirculation pumps, tripping of the turbine generator set, isolation of the main condenser, and loss of offsite power).

### 11.1 Source Terms

This section of the Fermi 3 Combined License (COL) Final Safety Analysis Report (FSAR) addresses sources of radioactivity that are generated within the core and have the potential of leaking into the reactor coolant system during normal operation, including an AOO, by way of defects in the fuel cladding. There are two types of source terms for the reactor primary coolant and steam. The first addresses the design basis, and the second describes the anticipated average concentrations in reactor coolant and steam over the life of a boiling-water reactor.

Section 11.1 of the Fermi 3 COL FSAR, Revision 7, incorporates by reference Section 11.1 of the Economic Simplified Boiling-Water Reactor (ESBWR) Design Control Document (DCD), Revision 10, referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix E, "Design Certification Rule for the Economic Simplified Boiling-Water Reactor," with no departures or supplements. The U.S. Nuclear Regulatory Commission (NRC) staff's finding related to information incorporated by reference is in NUREG—1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design." The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the application and checked the referenced DCD to ensure that no issues relating to this section remained for review.<sup>1</sup> The NRC staff's review confirmed that there are no outstanding issues related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to source terms are resolved.

### 11.2 Liquid Waste Management System

#### 11.2.1 Introduction

The liquid waste management system (LWMS) is designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including AOOs. The LWMS is designed to reduce and control releases of radioactive material into the environment. The LWMS comprises the following four types of major subsystems that are permanently installed equipment connected to other equipment, thus permitting liquid wastes from various plant systems to be segregated and processed separately:

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in Section 1.2.2 of the safety evaluation report (SER), for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

- (1) equipment (low conductivity) drain subsystem
- (2) floor (high conductivity) drain subsystem
- (3) chemical drain subsystem
- (4) detergent drain subsystem

The LWMS process subsystems rely on mixed bed demineralizers, charcoal filters and beds, cartridge filters, reverse osmosis, and organic and neutralization treatments. Cross-connections between subsystems provide additional flexibility in processing wastes by alternate methods and provide redundancy if one subsystem is inoperative. The LWMS normally operates on a batch basis. The system provides for sampling at several process points, administrative controls, and detection and alarms in cases of abnormal conditions against accidental discharges into the environment. The LWMS is located in the radwaste building (RWB). Airborne releases from the LWMS and ventilation exhaust systems servicing radiologically controlled areas are conducted through the RWB stack.

### 11.2.2 Summary of Application

Section 11.2 of the Fermi 3 COL FSAR, Revision 7, incorporates by reference Section 11.2 of the certified ESBWR DCD, Revision 10. In addition, in FSAR Section 11.2, the applicant provides the following:

#### COL Items

- STD COL 11.2-1-A Implementation of IE Bulletin 80-10

This COL item addresses LWMS subsystem interfaces and connections that are considered nonradioactive but that could later become radioactive through improper interfaces with radioactive systems, as described in the guidance and information in Inspection and Enforcement (IE) Bulletin 80-10, "Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release to Environment," dated May 6, 1980.

- STD COL 11.2-2-A Implementation of Part 20.1406

This COL item addresses compliance with 10 CFR 20.1406, "Minimization of Contamination," as it relates to the design and operational procedures of LWMS treatment subsystems. In Subsection 11.2.2.3 of the Fermi 3 COL FSAR, the applicant provides additional information identifying various sections of the FSAR (Sections 12.3, 12.5, 12.4, and 13.5) that address how to comply with the requirements of 10 CFR 20.1406.

#### Supplemental Information

- EF3 SUP 11.2-1 Implementation of Section II.D of Appendix I to Part 50 (cost-benefit analysis)

Section 11.2.1 of the Fermi 3 COL FSAR provides plant- and site-specific cost-benefit analysis. The cost-benefit analysis is based on the guidance of Regulatory Guide (RG) 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (for Comment)," issued in March 1976. RG 1.110 describes the results that demonstrate compliance with the as low as is reasonably achievable (ALARA) cost-benefit requirements in Section II.D of Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion As Low as is Reasonably Achievable for Radioactive Material in

Light-Water-Cooled Nuclear Power Reactor Effluents,” to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities.” The supplemental information presents a cost-benefit analysis demonstrating that any augmentation of the LWMS treatment subsystem is not cost beneficial. The applicant provided additional information on the cost parameters used to determine the total annual cost for the lowest cost systemic augmentation and concluded that no augmentations would be cost beneficial.

- EF3 SUP 11.2-2 Ground Water Protection

In Subsection 11.2.3.2 of the Fermi 3 COL FSAR, the applicant provides supplemental information addressing the monitoring program for the LWMS and plant blowdown underground piping in response to Request for Additional Information (RAI) 12.03-12.04-6 dated August 1, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11215A102).

### **11.2.3 Regulatory Basis**

The regulatory basis for information incorporated by reference is in NUREG-1966. In addition, the relevant requirements of the Commission regulations for the LWMS, and the associated acceptance criteria, are in Section 11.2 of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, (LWR Edition),” the Standard Review Plan (SRP).

NRC staff also followed the guidance in RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” issued in June 2007, to evaluate Section 11.2 of the Fermi 3 FSAR for compliance with NRC regulations.

In particular, the regulatory basis for the acceptance of the COL items and supplementary information on the LWMS appears in the following:

- Appendix B, “Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage,” to 10 CFR Part 20, “Standards for Protection against Radiation”
- 10 CFR 20.1406, “Minimization of contamination”
- 10 CFR 50.34a, “Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors”
- Sections II.A and II.D of Appendix I to 10 CFR Part 50

The following RGs and NRC documents contain regulatory guidance and positions that may be used in demonstrating compliance with the relevant requirements of the regulations identified above:

- RG 1.109, Revision 1, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I,” October 1977
- RG 1.110



- STD COL 11.2-1-A Implementation of IE Bulletin 80-10

*The guidance from Bulletin 80-10 includes information on the identification and restriction of non-contaminated systems that have the potential of becoming contaminated. The applicant has addressed this COL information item in the COL application with STD COL 11.2-1-A. In FSAR Section 11.2.2.3, "Detailed System Component Description," the applicant proposes to use specific equipment connection configurations and plant sampling. Specifically, the use of double-check valves in each line where a non-radioactive system is connected to a radioactive or potentially radioactive system. A tell-tale connection is proposed for installation in each line to confirm the integrity of the line and check valves. FSAR, Revision 0, stated that to ensure that contamination has not occurred in permanently installed clean systems, sampling of these systems further upstream has been included in the plant sampling program.*

*FSAR Section 11.2.2.3 presents an updated description of some portions of the LWMS that sample the permanently installed non-radioactive plant system in upstream locations of radioactive systems, to avoid uncontrolled and unmonitored releases into the environment. A review of that information indicates that there is no specific information describing those sampling provisions or where samples would be collected to confirm that clean plant systems have not been cross-contaminated by radioactive process streams. This information would ensure that appropriate provisions are identified in the FSAR and are not likely to be omitted during the development of the sampling and analysis program for the North Anna 3 ODCM (Offsite dose calculation manual), confirming compliance with liquid effluent concentration limits of Table 2 in Appendix B to 10 CFR Part 20 and design objectives in Appendix I to 10 CFR Part 50. Accordingly, RAI 11.02-2 requested the applicant to update FSAR Section 11.2.2.3 with specific references to the DCD and/or other FSAR sections where this information is provided and, if not, to supplement the appropriate FSAR sections with additional details. The applicant responded by providing additional information and proposed a revision to STD COL 11.2-1-A. The revision clarifies that plant procedures would describe the sampling of non-radioactive systems that could become potentially contaminated through the improper interface with radioactive systems. The proposed revision also notes that the determination of which system to consider and sample would be based on the requirements contained in the plant ODCM. The ODCM takes into account site-specific conditions and guidance from RG 1.109 in identifying exposure pathways and offsite dose receptors. The staff finds that these design features and operational program demonstrate compliance with IE Bulletin 80-10 and are therefore acceptable. This RAI is closed.*

The staff thus concluded that STD COL 11.2-1-A is consistent with IE Bulletin 80-10 and is therefore acceptable.

- STD COL 11.2-2-A Implementation of Part 20.1406

Subsection 12.3.1.5 of the Fermi 3 COL FSAR addresses this COL item by providing information on design, operational, and programmatic considerations to minimize contamination

and ensure compliance with 10 CFR 20.1406. The staff's evaluation of this information is in Section 12.3.4 of this SER.

Supplemental Information

- EF3 SUP 11.2-1 Implementation of, Section II.D of Appendix I to Part 50 (cost-benefit analysis)

The applicant used the guidance in RG 1.110 to determine when it is economically feasible to implement an augmented system to reduce radiation exposure below the regulatory threshold. The applicant indicated that the conceptual design of the ESBWR already contains all of the liquid radwaste augmentations identified in RG 1.110. Therefore, the applicant concluded that a cost-benefit analysis is not necessary. In addition, the ESBWR LWMS is designed with the capacity to recycle 100 percent of liquid radwaste (zero liquid release), as noted in ESBWR DCD, Table 11.5-7. However, the applicant reported the collective radiation doses for the liquid pathway in Chapter 12, Table 12.2-204 of the Fermi 3 COL FSAR. This analysis was inconsistent with the assumption of zero liquid release. Therefore, the staff issued RAI 11.02-1 asking the applicant to perform an appropriate cost-benefit analysis using the method and data outlined in RG 1.110.

In the response to this RAI dated April 8, 2009 (ADAMS Accession No. ML091060496), the applicant provides a detailed analysis demonstrating that the design of the Fermi 3 LWMS complies with the ALARA cost-benefit requirements in Section II.D of Appendix I to 10 CFR Part 50. The applicant uses RG 1.110 methodology and provides the cost parameters taken without exception from RG 1.110. The applicant revised FSAR Section 11.2.1 and provided the results of the cost-benefit analysis and supporting data using the guidance in RG 1.110. The applicant's analysis shows that the lowest cost option for the LWMS augmentation is a 75.7-liter-per-minute (Lpm) (20-gallon-per-minute [gpm]) filter cartridge at a cost of \$11,900 per year, resulting in a corresponding collective dose of 11.9 person-rem to the total body or thyroid. Subsection 12.2.2.4.2 of the Fermi 3 COL FSAR states that annual collective population doses resulting from liquid effluent releases are estimated to be 14.9 person-rem to the total body and 30.1 person-rem to the thyroid based on the LWMS described in the ESBWR DCD. Given that the 75.7-Lpm (20-gpm) filter cartridge augmentation would treat only 20 percent of the total liquid radwaste discharge, the resulting cost-benefit ratio is greater than the \$1,000 per person-rem criterion in Section II.D of Appendix I to 10 CFR Part 50, for both the total body and thyroid. Thus, the applicant concluded that the LWMS meets the ALARA requirement and no further system augmentations are necessary.

The staff conducted an independent assessment of the applicant's cost-benefit analysis using the information in the response to this RAI and in FSAR Subsection 12.2.2.4.2 about collective population doses, as well as the guidance in RGs 1.110 and 1.109. The staff's analysis find exact agreement with the applicant's cost-benefit results. Therefore, the staff finds that EF3 SUP 11.2-1 meets the requirements of Section II.D of Appendix I to 10 CFR Part 50 and is therefore acceptable, and RAI 11.02-1 is resolved.

- EF3 SUP 11.2-2 Ground Water Protection

In Subsection 11.2.3.2 of the Fermi 3 COL FSAR, the applicant provides supplemental information addressing the monitoring program for the LWMS and plant blowdown underground piping, in response to RAI 12.03-12.04-6. In SER Section 12.3.4 under COL Item

STD COL 12.3-4-A, the staff evaluated the required monitoring program for the underground piping to ensure that the potential for unmonitored, uncontrolled releases of radioactivity into the environment is minimized, in accordance with the requirements of 10 CFR 20.1406. Therefore, the staff finds EF3 SUP 11.2-2 acceptable.

#### **11.2.5 Post-Combined License Activities**

There are no post COL activities related to this section.

#### **11.2.6 Conclusion**

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant addressed the required information related to the LWMS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the LWMS that were incorporated by reference are resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.2, NRC RGs, and industry standards. The staff's concludes that the LWMS (as a permanently installed system and in combination with other plant systems) includes the equipment necessary to control releases of radioactive materials in liquid effluents, in accordance with the requirements in 10 CFR 50.34a. Furthermore, the staff concludes that the LWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance in RGs 1.109 and 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- Using site-specific conditions, the applicant meets the ALARA criterion required in Section II.D of Appendix I to 10 CFR Part 50. The staff considers the potential effectiveness of augmenting the LWMS using items of reasonably demonstrated technology. The staff determines that further treatment is not expected to produce further reductions in collective population doses reasonably expected within an 80-kilometer (50-mile) radius of the reactor, at a cost of less than \$1,000 per person-rem or person-thyroid-rem.
- The staff determines that the applicant adequately addressed the standard COL items regarding IE Bulletin 80-10 and 10 CFR 20.1406.

## **11.3 Gaseous Waste Management System**

### **11.3.1 Introduction**

The gaseous waste management system (GWMS) is designed to receive and process radioactive gases and hydrogen-bearing gases generated during process operation. The gaseous radioactive effluents come from two main sources in the plant: (1) building ventilation systems servicing radiologically controlled areas; and (2) the power cycle offgas system (OGS). The GWMS and its OGS are used to control, collect, process, hold for decay, and discharge gaseous radioactive wastes generated during normal operation, including AOOs. The OGS is located in the turbine building and its major components include preheaters; recombiners; cooler/condensers; dryers; activated charcoal beds (guard and delay); and associated valves, pumps, and instrumentation. The gases removed from the condenser are radioactive. They must therefore be treated before being released into the environment to ensure that radioactivity levels are reduced to acceptable levels and are ALARA. The GWMS is designed to reduce and control radioactivity releases into the environment. Releases from the OGS are conducted via the turbine building stack. Releases from building ventilation exhaust systems servicing radiologically controlled areas are conducted through their respective buildings: reactor/fuel building stack, turbine building stack, and RWB stack.

### **11.3.2 Summary of Application**

Section 11.3 of the Fermi 3 COL FSAR, Revision 7, incorporates by reference Section 11.3 of the certified ESBWR DCD, Revision 10. In addition, in FSAR Section 11.3, the applicant provides the following:

#### Supplemental Information

- EF3 SUP 11.3-1 Implementation of Section II.D of Appendix I to Part 50 (cost-benefit analysis)

The applicant used RG 1.110 as the basis for a cost-benefit evaluation to assess gaseous radwaste system augmentations. The results of the cost-benefit analysis demonstrate compliance with the ALARA cost-benefit requirements in Section II.D of Appendix I to 10 CFR Part 50. The applicant considered augmentations applicable to the ESBWR conceptual design and concluded that no gaseous radioactive waste system augmentations are cost beneficial.

### **11.3.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966. In addition, the relevant requirements of the Commission regulations for the GWMS, and the associated acceptance criteria, are in Section 11.3 of the SRP.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.3 of the Fermi 3 COL FSAR for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the supplementary information on GWMS appears in the following:

- 10 CFR 50.34a



- Sections II.B, II.C, and II.D of Appendix I to 10 CFR Part 50

The following RGs and NRC documents contain regulatory guidance and positions that may be used in demonstrating compliance with the relevant requirements of the regulations identified above:

- RG 1.109
- RG 1.110

#### 11.3.4 Technical Evaluation

As documented in NUREG-1966, NRC staff reviewed and approved Section 11.3 of the certified ESBWR DCD. The staff reviewed Section 11.3 of the Fermi 3 COL FSAR, Revision 7 and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the GWMS.

The staff reviewed the relevant information in the supplement. The following paragraphs discuss the staff's evaluations of the applicant's information on specific technical and regulatory topics.

##### Supplemental Information

- EF3 SUP 11.3-1 Implementation of Section II.D of Appendix I to Part 50 (cost-benefit analysis)

The applicant included a plant- and site-specific cost-benefit analysis to justify, in part, the GWMS design. The applicant based the cost-benefit analysis on the guidance in RGs 1.110 and 1.109, and the results demonstrate compliance with the ALARA cost-benefit requirements in Section II.D of Appendix I to 10 CFR Part 50. The applicant's analyses assessed the merits of installing (1) a 3-ton charcoal absorber, (2) charcoal vault refrigeration, (3) a main condenser vacuum pump charcoal/high-efficiency particulate air (HEPA) filtration system, (4) a 424.75-cubic-meter-per-minute (15,000-cubic-foot-per-minute) HEPA filtration system, (5) a charcoal/HEPA filtration system, and (6) a 17-cubic-meter (600-cubic-foot) gas decay tank. The applicant concluded that none of these system improvements is cost beneficial and therefore, the applicant did not propose any system augmentations.

The staff performed an independent assessment of the applicant's cost-benefit analysis using information in the application. But lacking the specific details of the applicant's analysis, the staff was unable to reproduce those results. Therefore, the staff issued RAI 11.03-1 asking the applicant to provide additional information on the approach used to conduct the GWMS cost-benefit analysis.

In the response to this RAI dated April 23, 2009 (ADAMS Accession No. ML091250352), the applicant clarified the approach used to conduct the GWMS cost-benefit analysis. The applicant identified RG 1.110 as the basis for the GWMS cost-benefit analysis. The staff reviewed the

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

calculations and found exact agreement with the applicant's cost-benefit results. Therefore, the staff determined that none of the GWMS augmentations is cost beneficial.

In March 2010, Revision 7 of the ESBWR DCD was issued with the revised gaseous effluent source term. The applicant issued Revision 2 of the Fermi 3 COL FSAR in March 2010 but did not revise the gaseous source term to be consistent with the DCD. Therefore, the use of the population doses based on the gaseous effluent in DCD Revision 6 was no longer valid for the cost-benefit analysis. In February 2011, the applicant issued Revision 3 of the Fermi 3 COL FSAR with new population dose values based on the site-specific reactor water radioiodine concentrations, as explained in Section 12.2.4 of this SER. The staff reviewed the new cost-benefit analysis results and agreed with the applicant's restated conclusion that none of the augmentations is cost beneficial. Therefore, RAI 11.03-1 is resolved.

The staff determined that the GWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance of RGs 1.109 and 1.110. This conclusion is based on the staff's finding that using site-specific conditions, the applicant has met the ALARA criterion required in Section II.D of Appendix I to 10 CFR Part 50. The staff considered the potential effectiveness of augmenting the GWMS using items of reasonably demonstrated technology. The staff determined that additional treatment is not expected to produce further reductions in collective population doses, reasonably expected within an 80-kilometer (50-mile) radius of the reactor at a cost of less than \$1,000 per person-rem or person-thyroid-rem.

#### **11.3.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **11.3.6 Conclusion**

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant addressed the required information related to the GWMS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the GWMS that were incorporated by reference are resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.3, NRC RGs, and industry standards. The staff concludes that the GWMS includes the equipment necessary to control releases of radioactive materials in gaseous effluents in accordance with the requirements in 10 CFR 50.34a. Furthermore, the staff concludes that the GWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance of RGs 1.109 and 1.110.

## **11.4 Solid Waste Management System**

### **11.4.1 Introduction**

- The Solid Waste Management System (SWMS) is designed to provide collection, processing, packaging, and storage of radioactive wastes such as spent resins, sludge, oil waste, and dry active waste (DAW) produced during normal operation and AOOs including startup, shutdown, and refueling operations. The SWMS is located in the RWB and is designed to collect, process, control, package, and temporarily store wet and dry solid radioactive wastes before shipment. The SWMS processes wastes from the LWMS, reactor water cleanup/shutdown cooling system, fuel and auxiliary pools cooling system, and condensate purification system. The SWMS comprises the following four subsystems:
  - SWMS collection subsystem
  - SWMS processing subsystem
  - dry solid waste accumulation and conditioning subsystem
  - container storage subsystem

The SWMS collection subsystem consists of high- and low-activity resin holdup tanks, phase separators, a condensate resin holdup tank, decant pumps, sampling points, control panels, instrumentation, vents and drains, and high- and low-activity transfer pumps. There are no provisions to release liquid and gaseous wastes directly from the SWMS system. All liquid effluent releases are conducted through the LWMS for process liquids generated during the operation of the SWMS. Airborne releases from the SWMS and ventilation exhaust systems servicing radiologically controlled areas, where process equipment is located, are monitored and discharged through the RWB stack.

The container storage subsystem and the dry solid waste accumulation and conditioning subsystem are conceptual descriptions of methods the COL licensee would use to handle and process solid wastes and packaged solid wastes. Therefore, the DCD describes the process without including equipment and system flow diagrams. Figures 11.4-1 and 11.4-4 in DCD Tier 2, Revision 9 provide overviews of the processes that would be used to handle dry solid and wet wastes. The COL applicant will address the actual processes in its operational programs and procedures, which will consider the regulatory requirements of the NRC, U.S. Department of Transportation (DOT), and State and local agencies for processing, storing, packaging, shipping, radiological monitoring, and disposing of radioactive wastes.

### **11.4.2 Summary of Application**

Section 11.4 of the Fermi 3 COL FSAR, Revision 7, incorporates by reference Section 11.4 of the certified ESBWR DCD, Revision 10. In addition, in FSAR Section 11.4, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- EF3 DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The ESBWR DCD identifies that the RWB provides onsite storage space for a 6-month volume of packaged waste. The applicant states that Departure EF3 DEP 11.4-1 configures the Fermi 3 RWB to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This departure is accomplished by reconfiguring the arrangement of systems and components within the design of the ESBWR RWB. The applicant provides various revised tables and figures for the new arrangement of systems and components in the reconfigured RWB.

COL Items

- STD COL 11.4-1-A SWMS Processing Subsystem Regulatory Guide Compliance

The COL applicant is responsible for ensuring that SWMS subsystems comply with the guidance of RG 1.143, Revision 2, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," and RG 8.8 Revision 3, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," issued in June 1978 for the testing and operation of all SWMS subsystems. The applicant provides additional information on the SWMS testing according to guidance in RG 1.143 and RG 8.8.

- STD COL 11.4-2-A Compliance with IE Bulletin 80-10

This COL item addresses the evaluation of the SWMS subsystems against the guidance and information in IE Bulletin 80-10 in identifying and rectifying connections to systems that are considered nonradioactive, but that could become radioactive through improper interfaces with radioactive systems (i.e., a nonradioactive system that could become contaminated as a result of leakage, valving errors, or other operating conditions in radioactive systems). The applicant provides additional details about the types of design features, including the installation of double check valves and tell-tale connections, for the purpose of confirming the integrity of SWMS piping and connections. Normal sample points are provided further upstream will be included in the plant-specific sampling program.

- STD COL 11.4-3-A Process Control Program

The applicant includes by reference Nuclear Energy Institute (NEI) 07-10A, Revision 0, "Generic FSAR Template Guidance for Process Control Program (PCP)," issued in March 2009 (ADAMS Accession No. ML091460627), as the basis for the PCP. The applicant notes that Section 13.4 of the Fermi 3 COL FSAR addresses the milestones for developing and implementing the PCP.

- STD COL 11.4-4-A Temporary Storage Facility

In Revision 2 of the Fermi 3 COL FSAR, the applicant indicates that the RWB was reconfigured to accommodate at least 10 years of packaged Class B and C waste and approximately 3 months of packaged Class A waste, during routine operations and AOOs.

- STD COL 11.4-5-A Compliance with Part 20.1406

This COL item addresses site-specific information for demonstrating compliance with 10 CFR 20.1406 and RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," issued in June 2008, as it relates to the design and operational procedures of SWMS treatment subsystems to minimize contamination, facilitate eventual decommissioning, and minimize the generation of radioactive waste. In Section 11.4.1 of the Fermi 3 COL FSAR, the applicant provides additional information identifying various sections of the FSAR (Sections 12.3, 12.4, 12.5, and 13.5) that address how to comply with the implementation of 10 CFR 20.1406.

#### Supplemental Information

- EF3 SUP 11.4-1 Implementation of Section II.D of Appendix I to Part 50 (cost-benefit analysis)

In Section 11.4.1 of the Fermi 3 COL FSAR, Revision 2, the applicant presents supplemental information on the cost-benefit analysis for the SWMS and references the cost-benefit analyses in FSAR Sections 11.2.1 and 11.3.1 for processing and treating liquid and gaseous effluents as byproducts of the SWMS operation. Hence, no augmentations are needed for the SWMS.

#### **11.4.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is in NUREG-1966. In addition, the relevant requirements of the Commission regulations for the SWMS, and the associated acceptance criteria, are in Section 11.4 of NUREG-0800.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.4 of the Fermi 3 COL FSAR for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the supplementary information on the SWMS appears in the following:

- 10 CFR 20.1406
- Sections II.A, II.B, II.C and II.D of Appendix I to 10 CFR Part 50
- 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste"

The following RGs and NRC documents contain regulatory guidance and position that may be used in demonstrating compliance with the relevant requirements of the regulations identified above:

- RG 1.109
- RG 1.110
- IE 80-10
- RG 8.8
- RG 1.143

- Generic Letter (GL) 89-01, “Implementation of Programmatic and Procedural Controls for Radiological Effluent Technical Specifications”

In addition, in accordance with Section VIII, “Processes for Changes and Departures,” of “Appendix E to Part 52--Design Certification Rule for the Economic Simplified Boiling Water Reactor,” the applicant identifies one Tier 2 departure. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix E, Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59.

#### **11.4.4 Technical Evaluation**

As documented in NUREG-1966, NRC staff reviewed and approved Section 11.4 of the certified ESBWR DCD. The staff reviewed Section 11.4 of the Fermi 3 COL FSAR, Revision 7 and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to the SWMS.

In addition, the staff reviewed the applicant’s proposed resolution to the COL items and the departure included in Section 11.4 of the Fermi 3 COL FSAR. The staff used the applicable sections of the SRP and RG 1.206 as guidance.

As stated above, Section 1.2.3 of this SER discusses the NRC’s strategy for performing one technical review for each standard issue outside the scope of the design certification and to use this review to evaluate the subsequent COL applications. To ensure that the staff’s findings on standard content that were documented in the SER for North Anna Unit 3 are equally applicable to the Fermi 3 COL application, the staff undertook the following reviews:

- The staff compared the North Anna Unit 3 COL FSAR, Revision 1, to the Fermi 3 COL FSAR, Revision 3. In performing this comparison, the staff considered changes made to the Fermi 3 COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs and open and confirmatory items identified in the North Anna SER with open items.
- The staff confirmed that the applicant has endorsed all responses to the RAIs identified in the corresponding standard content evaluation (the North Anna SER).
- The staff verified that the site-specific differences are not relevant to this section of the Fermi 3 COL application.

The staff completed the review and found the evaluation of the North Anna standard content to be applicable to the Fermi 3 COL application. This SER identifies the standard content material with italicized, double-indented formatting.

The staff reviewed the information in the Fermi 3 COL FSAR as follows:

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<sup>1</sup> See “*Finality of Referenced NRC Approvals*” in SER Section 1.2.2 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 2 Departure Not Requiring Prior NRC Approval

- EF3 DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

This departure identifies a plant-specific deviation from design information in the ESBWR DCD for low-level radioactive waste storage. The Fermi 3 RWB is configured to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. The departure is accomplished by reconfiguring the arrangement of systems and components within the ESBWR RWB. The applicant provides various figures and tables in Section 11.4 of the Fermi 3 COL FSAR to identify changes in equipment and systems. The applicant also adds figures and tables to Section 12.3 that identify the revised layout and radiation protection needs. The major change to Section 11.4 is the elimination of the condensate resin transfer pumps and the addition of high- and low-activity circulation pumps (Figures 11.4-1R and 11.4-2R and Table 11.4-1R). In addition, the applicant identifies the estimated annual volume of radwaste requiring long-term management in FSAR Table 11.4-2R.

In Part 7, "Departure Report," of the COL application Revision 2, the applicant provided the results of its evaluation of this departure. The applicant added that the departure affects both the Tier 1 and Tier 2 information, but the departure has no safety significance. The applicant identified the Tier 1 changes as changes to the description of the locations of area radiation monitors in the RWB.

The staff reviewed the applicant's information in Parts 2, 7, and 10 of the COL application. The revised Table 2.3.2-1 reports the changes affecting Part 10 that relate to inspections, tests, analyses, and acceptance criteria (ITAAC). A comparison of this table to the table in ESBWR DCD, Tier 1, Table 2.3.2-1, reveals that the proposed changes relate to the RWB layout changes, specifically to the renaming of the assigned locations. The staff found that this name change does not present a risk to public health and safety.

The applicant's supplemental response to RAI 11.04-2 dated June 17, 2011 (ADAMS Accession No. ML11171A297), eliminates the Tier 1 changes previously provided under Departure EF3 DEP 11.4-1 in Parts 7 and 10 of the COL application. The applicant eliminates the proposed name changes in the description and locations and reverts back to the original names listed in ESBWR DCD, Tier 1 and Tier 2. The staff reviewed these name changes and concurred with the applicant that the proposed changes are consistent with the ESBWR DCD, and EF3 DEP 11.4-1 does not affect Tier 1 information and ITAAC.

With regard to storage capacity, Table 11.4-2-R shows that Class B and C wastes are generated at a rate of about 15.6 cubic meters per year ( $m^3/yr$ ) (552 cubic feet per year [ $ft^3/yr$ ]), requiring  $156 m^3$  ( $5,520 ft^3$ ) of storage volume for a 10-year inventory. The same table shows a 3-month Class A waste volume of  $91 m^3/yr$  ( $3,210 ft^3/yr$ ) for DAW and about  $24 m^3/yr$  ( $874.6 ft^3/yr$ ) for wet solid waste. Figure 1.2-23R (depicting the RWB at elevation 4650) indicates the storage of Class B and C wastes in Room 6390, Class A wet solid waste in Room 6391, and Class A DAW in Room 6392. The staff reviewed these rooms and determined that all three rooms have sufficient surface area and volume to store the waste for the required period. Therefore, the staff concluded that the new storage areas for managing Class A, B, and C radioactive wastes have sufficient volume to accommodate the accumulated waste.

The staff's review of Figures 11.4-1R and 11.4-2R in the Fermi 3 COL FSAR noted that the SWMS process diagram includes dual pumps in series in two places, with no holding tank or

other equipment separating the pumps. This configuration is shown for (1) the reactor water cleanup system/fuel and auxiliary pools cooling system, with the top process line indicating the high-activity circulation and high-activity transfer pumps; and (2) the condensate filter backwash drain/equipment-floor drain subsystem filter backwash drain/dewatering fill head, with the lower process line indicating the low-activity circulation and low-activity transfer pumps. The diagram shows these pumps as dual pumps in series, but it does not indicate whether these pumps provide redundancy because they lack isolation valves. The staff issued RAI 11.04-4 asking the applicant to clarify the system and the use of the identified pumps. The applicant's response to this RAI dated June 17, 2011 (ADAMS Accession No. ML11171A297), provides additional information on the design changes and operation of the pumps. The applicant identifies the pumps in series as air-operated diaphragm pumps, which are not prone to cavitation. The staff's review of the applicant's response determined that the applicant has provided adequate information to meet the guidance of RG 1.143. In addition, the staff agreed with the applicant's statement that these pumps are not prone to cavitation. The diaphragm pumps can operate at an infinitely variable pumping rate and pressure, they can run dry indefinitely, and their discharge can be throttled to zero flow. Therefore, this RAI is resolved. However, a further review of the SWMS process diagrams (FSAR Figures 11.4-1R and 11.4-2R) identified inconsistencies between them. The staff informed the applicant of these inconsistencies on July 14, 2011. The applicant's supplemental response to RAI 11.04-4 dated August 24, 2011 (ADAMS Accession No. ML11238A049), provides a revised FSAR Figure 11.4-1R correcting the inconsistencies. The staff found that this figure is consistent with the process diagram in FSAR Figure 11.4-2R, and this RAI is closed. The staff tracked the verification that the next FSAR revision includes this change as Confirmatory Item 11.04-4. The staff verified that FSAR Revision 4 includes the revised Figure 11.4-1R. Therefore, Confirmatory Item 11.04-4 is resolved.

In the supplemental response to RAI 11.04-4 dated August 24, 2011, the applicant states that Departure EF3 DEP 11.4-1 only affects Tier 2, and its evaluation determined that this departure does not require prior NRC approval in accordance with Appendix E to 10 CFR Part 52. The NRC staff finds it reasonable that the departure does not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

#### COL Items

- STD COL 11.4-1-A SWMS Processing Subsystem Regulatory Guide Compliance

The following portion of this technical evaluation section is reproduced from Section 11.4.4 of the North Anna Unit 3 SER (ADAMS Accession No. ML091670733):

- *STD COL 11.4-1-A SWMS Processing Subsystem Regulatory Guide Compliance*

*The COL item addresses the compliance of the SWMS subsystems with the guidance in RG 1.143, Revision 2, and RG 8.8 for the testing and operation of all SWMS subsystems. The applicant addressed this information item in STD COL 11.4-1-A. The applicant notes that SWMS subsystems used to process wet solid radioactive wastes are tested using a process that complies with RG 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-*



*Cooled Nuclear Power Plants.” The staff finds that the information provided by the applicant is acceptable. Therefore, COL Item 11.4.-1-A has been satisfied. The evaluation of the compliance with RG 8.8 is addressed in Section 12.1 of the SER.*

The applicant supplemented STD COL 11.4-1-A with EF3 SUP 11.4-1. As described in Section 12.1 of the SER, the applicant’s additional information is consistent with RG 1.143 and RG 8.8 and is therefore acceptable.

- *STD COL 11.4-2-A Compliance with IE Bulletin 80-10*

*The COL item addresses the evaluation of the SWMS subsystems against the guidance and information in IE Bulletin 80-10. The purpose is to identify and rectify connections to systems that are considered nonradioactive but that could become radioactive through improper interfaces with radioactive systems (i.e., a non-radioactive system that could become contaminated due to leakage, valving errors, or other operating conditions in radioactive systems). Bulletin 80-10 includes information on identifying and restricting non-contaminated systems that could become contaminated.*

*The applicant has addressed this COL information item in the COL application with STD COL 11.4-2-A. FSAR Section 11.4.2.3, “Detailed System Component Description,” presents an updated description of some portions of the SWMS on sampling permanently installed non-radioactive plant system in upstream locations of radioactive systems. These provisions are intended to avoid uncontrolled and unmonitored releases into the environment. Specifically, the applicant proposes using double-check valves in each line where a non-radioactive system is connected to a radioactive or potentially radioactive system. These valves are expected to service subsystems connected to non-radioactive portable systems. The installation of tell-tale connection in each line is expected to confirm the integrity of the line and check valves. FSAR, Revision 0, stated that to ensure that contamination has not occurred in permanently installed clean systems, sampling these systems further upstream is included in the plant sampling program.*

*A review of the above information indicates that there is no FSAR specific description of those sampling provisions, or where samples would be collected, to confirm that clean plant systems have not been cross-contaminated by radioactive process streams. Accordingly, the applicant was requested under RAI 11.04-2 to update FSAR Section 11.4.2.3 with specific references to ESBWR DCD and/or other FSAR sections where this information is provided, or to supplement the appropriate FSAR sections with additional details. The purpose of this RAI is to ensure that these provisions are identified in the FSAR and are not likely to be omitted during the development of the sampling and analysis program for the North Anna 3 ODCM, and for confirming compliance with liquid effluent concentration limits in Table 2 (Column 2) in Appendix B to 10 CFR Part 20 and design objectives of Appendix I to 10 CFR Part 50. The applicant responded with a proposed revision to FSAR Section 11.4.2.3.5. The revised section identifies plant-specific procedures and notes that the ODCM would address potential*

*conditions where normally non-radioactive systems might become contaminated. The staff finds that these design features and operational program demonstrating compliance with IE Bulletin 80-10. The staff therefore finds the response acceptable, and this RAI is closed.*

In Subsection 11.4.2.3.5 of the Fermi 3 COL FSAR, Revision 7 the applicant states that plant-specific procedures describe the sampling of nonradioactive systems that could potentially become contaminated by cross-connection with systems that contain radioactive material. In addition, the ODCM will address potential conditions where normally nonradioactive systems might become contaminated. The staff finds this information to be consistent with IE Bulletin 80-10 and therefore acceptable.

- *STD COL 11.4-3-A Process Control Program*

*The COL item addresses the implementation of a plant-specific PCP using operating procedures and technical specifications, as they relate to the classification, treatment, and disposal of radioactive wastes processed by the SWMS in accordance with NRC, DOT and State and local agency regulatory requirements. The applicant includes, by reference, NEI Template 07-10 as the basis for the PCP. The NEI template presents the functional elements of a PCP, which, if met, would demonstrate compliance with 10 CFR 50.34a and 50.36a. The template describes technical and regulatory considerations used to process solid, wet, and liquid wastes with selected waste processing technologies and methods. The PCP identifies surveillance requirements that are consistent with the plant's technical specifications, administrative procedures, operational procedures, quality assurance and quality control program, radiological controls and monitoring program, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, instructions on using the NRC uniform radioactive shipping waste manifest, and the process for initiating and documenting changes to the North Anna 3 PCP and its supporting procedures. The basis for acceptance in the staff's review is conformance of the applicant's endorsement of the DCD SWMS design and proposed North Anna 3 PCP. The milestones for the development and implementation of the PCP are addressed in FSAR, Revision 1, Section 13.4 of the North Anna 3 COL. NRC staff finds that this item is satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (item 9), which lists the milestones for the development and implementation of the PCP before fuel load, with the requirement identified as a license condition. The applicant was requested, under RAI 11.04-1B, to update this milestone in FSAR Section 11.4.2.3, STD COL 11.4-3-A by referencing NEI PCP Template 07-10 in applicable FSAR subsections and references. The applicant responded with a proposed revision to STD COL 11.4-3-A once NEI PCP Template 07-10 has been issued. NEI PCP Template 07-10A (Revision 0, March 2009) has been reviewed and found acceptable by the staff. The results of the staff's evaluation are presented in ML082910077 and the NEI PCP Template 07-10A is presented in ML091460236. The staff concluded that STD COL 11.4-3-A meets the requirements and is acceptable (process control program compliance with 10 CFR 50.34a and 50.36a).*

In Subsection 11.4.2.3.5 of the Fermi 3 COL FSAR, Revision 7 the staff finds the applicant's resolution of STD COL 11.4-3-A for waste classification and process control to be consistent with NEI 07-10A and is therefore acceptable. Section 13.4, "Operational Programs Required by NRC Regulations," of the Fermi 3 COL FSAR addresses the milestones for developing and implementing the PCP before the fuel loading. In Table 13.4-201, the applicant identifies the Commitment (COM 13.4-011) to track a license condition for implementation milestones related to the PCP. Commitment 13.4-011 is that same as Commitment 11.05-001 presented in FSAR Chapter 11.4. The staff reviewed the applicant's Commitment (COM 11.5-001) to address the milestones for developing and implementing the PCP and found the commitment acceptable. The staff designated Commitment (COM 13.4-011) as License Condition 11-1.

- STD COL 11.4-4-A Temporary Storage Facility

In previous revisions of the Fermi 3 COL FSAR, the applicant stated that Fermi 3 does not use any temporary storage facilities to support plant operation. The corresponding ESBWR DCD Tier 2 COL item states that it is the responsibility of the COL applicant to consider the development of an overall site management plan for the storage of radioactive waste using the guidance of SRP Section 11.4. Because Section 11.4.1 of the DCD states that the plant provides a storage capacity for 6 months, NRC staff issued RAI 11.04-2 asking the applicant to address the long-term management and storage of radioactive wastes.

In the response to this RAI dated April 8, 2009 (ADAMS Accession No. ML091060496), the applicant agreed to develop clarifying information for a future submission to the COL application. In March 2010, the applicant submitted FSAR Revision 2, which included supplemental information on the long-term management and storage of radioactive waste under Departure EF3 DEP 11.4-1. Therefore, this RAI is resolved. The staff evaluated the availability of temporary storage under Departure EF3 DEP 11.4-1.

- STD COL 11.4-5-A Compliance with Part 20.1406

The applicant states that FSAR Subsection 12.3.1.5 addresses this COL item. Subsection 12.3.1.5 provides information on design features as well as on measures used in operating procedures to minimize contamination and to ensure compliance with 10 CFR 20.1406. Section 12.3.4 of this SER provides the staff's evaluation of this information.

### Supplemental Information

- EF3 SUP 11.4-1 Implementation of Section II.D of Appendix I to Part 50 (cost-benefit analysis)

The applicant added a new supplement (EF3 SUP 11.4-1) to Section 11.4.1 of the Fermi 3 COL FSAR, Revision 2, which states that the cost-benefit analyses in Sections 11.2.1 and 11.3.1 include the incremental amounts of liquid and gaseous wastes that would be produced during the operation of the SWMS. As a result, no other SWMS design augmentations are necessary to handle the incremental amounts of liquid and gaseous wastes. The staff found the applicant's supplemental information acceptable, because the cost-benefit analyses in FSAR Sections 11.2 and 11.3 consider routinely expected sources of radioactivity discharged via the three plant stacks. For example, releases from the RWB ventilation exhaust systems servicing radiologically controlled areas—including the SWMS components—and the venting of SWMS tanks and vessels are conducted through the RWB stack. As a result, all releases from the SWMS are monitored and controlled at the release point, and all releases

controlled through the implementation of the ODCM. Therefore, the staff concluded that the applicant has adequately addressed EF3 SUP 11.4-1.

#### **11.4.5 Post Combined License Activities**

For the reasons discussed in the technical evaluation section above, the staff has identified the following license condition:

- License Condition (11-1) - At least 180 days before the date scheduled for initial fuel load as set forth in the notification submitted in accordance with 10 CFR 52.103(a), DTE Electric Company shall implement an operational program for process and effluent monitoring and sampling, including the subprogram and documents for a PCP. No later than 12 months after issuance of the COL, the licensee shall submit to the Director of the Office of New Reactors (NRO) a schedule that supports planning for and conduct of NRC inspections of the operational program for process and effluent monitoring and sampling (including the PCP). The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational program for process and effluent monitoring and sampling (including the PCP) has been fully implemented. (COM 13.4-011)

#### **11.4.6 Conclusion**

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the relevant information relating to the SWMS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the SWMS that were incorporated by reference are resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.4, NRC RGs, and industry standards. The staff concludes that the SWMS (as a permanently installed system and in combination with other plant systems) includes the equipment necessary to process liquid, wet, and dry solid wastes and contains provisions for controlling the release of radioactive materials in effluents in accordance with the requirements in 10 CFR 50.34a. The staff's review concludes that the SWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance in RGs 8.8, 1.143, 1.109 and 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- Using site-specific conditions, the applicant met the ALARA criterion required in Section II.D of Appendix I to 10 CFR Part 50, because all associated effluent releases are expected to be managed through the operation of the LWMS and GWMS. The staff considered the potential effectiveness of augmenting the LWMS and GWMS using items of reasonably demonstrated technology. The staff determines that additional treatment is not expected to produce further reductions in collective population doses reasonably expected within an 80-kilometer (50-mile) radius of the reactor, at a cost of less than \$1,000 per person-rem or person-thyroid-rem.
- The staff determines that the applicant adequately addressed the standard COL items regarding IE Bulletin 80-10 and 10 CFR 20.1406.



applicant incorporates by reference NEI 07-09A, Revision 0, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," dated March 31, 2009 (ADAMS Accession No. ML091050234). The ODCM is used to control and monitor all liquid and gaseous effluent releases and to implement an environmental sampling and monitoring program. Section 13.4 of the Fermi 3 COL FSAR addresses the milestones for the development and implementation of the ODCM. In addition, the applicant commits (COM 11.5-001) to include in the ODCM the provisions for sampling liquid and gaseous waste streams identified in Table 11.5-201 and DCD Table 11.5-7 and batch liquid releases identified in DCD Table 11.5-7.

- STD COL 11.5-3-A Process and Effluent Monitoring and Sampling Program

This COL item addresses the implementation of a site-specific monitoring and sampling program, as described in the ODCM for Fermi 3. In addition, the applicant includes Table 11.5-201 as a replacement for Table 11.5-5 in ESBWR DCD, Tier 2, which details provisions for sampling liquid streams.

- STD COL 11.5-4-A Site-Specific Offsite Dose Calculation

This COL item addresses compliance with the design objectives in Appendix I to 10 CFR Part 50 for controlling doses to a hypothetical maximally exposed member of the public and populations living near Fermi 3.

- STD COL 11.5-5-A Instrumentation Sensitivities

This COL item addresses the derivation of instrumentation detection sensitivity levels and bases for sampling all expected liquid and gaseous effluent release points described in the ODCM for Fermi 3.

### **11.5.3 Regulatory Basis**

The regulatory basis of the information incorporated by reference is NUREG-1966. In addition, the relevant requirements of the Commission regulations for the PRMS, and the associated acceptance criteria, are in Section 11.5 of NUREG-0800.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.5 of the Fermi 3 FSAR for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the additional information related to the PRMS appears in the following:

- 10 CFR 20.1301(e)
- 10 CFR 20.1302, "Compliance with dose limits for individual members of the public"
- 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors"
- 10 CFR 50.36a, "Technical specifications on effluents from nuclear power reactors"

- Sections II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50

The following RGs and NRC documents contain regulatory guidance and position that may be used in demonstrating compliance with the relevant requirements of the regulations identified above:

- GL 89–01

Additional requirements include those of 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii) for monitoring gaseous effluents from potential accident release points, consistent with GDC 63 and 64.

SRP acceptance criteria include industry codes and standards, such as American National Standards Institute/Health Physics Society N13.1 and American Nuclear Society ANS N42.18, and the guidance in the following NRC documents:

- RG 1.109
- RG 1.110
- RG 1.21, Revision 1, “Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants,” June 1974
- RG 1.33, Revision 2, “Quality Assurance Program Requirements (Operation),” February 1978
- RG 1.97, Revision 4, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants,” June 2006
- RG 4.1, Revision 2, “Radiological Environmental Monitoring for Nuclear Power Plants,” June 2009
- RG 4.15, Revision 2, “Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment,” July 2007
- BTP 7-10, Revision 5, “Guidance on Application of Regulatory Guide 1.97,” issued March 2007, in SRP Section 7.5





- *STD COL 11.5-1-A                      Sensitivity or Subsystem Lower Limit of Detection*

*The COL item addresses the derivation of lower limits of detection for each effluent PRMS subsystem, following the requirements of the ODCM for North Anna 3. The applicant outlines, given the endorsement of NEI ODCM Template 07-09, methods used to derive the lower limits of detection for PRMS subsystems in monitoring and controlling liquid and gaseous effluent releases. The milestones for the development and implementation of the ODCM are addressed in FSAR Revision 1, Section 13.4 of the North Anna 3 COL. NRC staff finds this item satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (item 9), which lists the milestones for the development and implementation of the ODCM before fuel load, with the requirement identified as a license condition.*

In Subsection 11.5.4.7 of the Fermi 3 COL FSAR, the applicant states that the ODCM will provide the methodology for deriving the lower limit of detection for the PRMS subsystem in monitoring and controlling liquid and gaseous effluent releases. DCD Tables 11.5-2 and 11.5-4 provide the estimated sensitivities of process radiation monitors. If the plant configuration and radiation background require changes to these sensitivity ranges, the ranges will be adjusted in accordance with written procedures consistent with the bases defined in DCD Table 11.5-9. The applicant will update the FSAR if changes to values in DCD Tables 11.5-2 and 11.05-4 are needed. The staff's review found that the applicant's response adequately addresses STD COL 11.5-1-A and the guidance in RGs 1.21, 1.33, 1.97, 1.206, 4.1, 4.15, and BTP 7-10 and complies with 10 CFR Part 20, 10 CFR Part 50.

- *STD COL 11.5-2-A                      Offsite Dose Calculation Manual*

*The COL item addresses the development of a plant- and site-specific ODCM for calculating offsite doses resulting from liquid and gaseous effluents. FSAR, Section 11.5.4.5. The applicant endorses by reference NEI ODCM Template 07-09 as the basis of its ODCM as an operational program document. The NEI template presents the functional elements of an ODCM that, if met, would demonstrate compliance with Part 50.34a and 50.36a and Appendix I to 10 CFR Part 50. The NEI ODCM Template identifies monitoring criteria, liquid and gaseous radiological effluent controls, monitoring instrumentation, methods for deriving lower limits of detection and detection sensitivities, methods for establishing instrumentation alarm set-points, dose limits for members of the public, requirements for process and effluent sampling in various plant systems, requirements limiting effluent releases, surveillance requirements, methods for calculating effluent release rates and doses, elements of a radiological environmental monitoring program, elements of a quality assurance and quality control program, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, process for initiating and documenting changes to the North Anna 3 ODCM and supporting procedures, and record keeping. The NRC staff finds this item satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (item 9), which lists the milestones for the development and implementation of the ODCM before fuel load as a license condition. Accordingly, the applicant was requested, under RAI 11.05-1, to update the provisions of FSAR, Revision 0, Section 11.5.4.5,*

*(STD COL 11.5-2-A), by referencing NEI ODCM Template 07-09 in applicable FSAR subsections and references. In its response, the applicant proposed a revision to STD COL 11.5-2-A once the final NEI ODCM Template 07-09 is issued. The NEI ODCM Template 07-09A (Revision 0, March 2009) has been reviewed and found acceptable by the staff. The results of the staff's evaluation are presented in ML083530745 and the NEI ODCM Template 07-09A is presented in ML091460258. The staff finds the response acceptable, and this RAI is Confirmatory Item 11.05-1 until the applicant updates the reference to the final ODCM.*

In Subsection 11.5.4.5 of the Fermi 3 COL FSAR, Revision 2, the applicant incorporates by reference the NEI 07-09A ODCM template as the basis of its ODCM. Therefore, Confirmatory Item 11.05-1 is resolved.

In addition, the applicant commits (COM 11.5-001) to include in the ODCM, before fuel load, the provisions for sampling liquid and gaseous waste streams identified in Table 11.5-201 and DCD Table 11.5-7 and batch liquid releases identified in DCD Table 11.5-7. Section 13.4, "Operational Programs Required by NRC Regulations," of the Fermi 3 COL FSAR addresses the milestones for developing and implementing the ODCM. In Table 13.4-201, the applicant identifies Commitment (COM 13.4-007), Commitment (COM 13.4-009) and Commitment (COM 13.4-010) to track license conditions for implementing milestones related to Commitment (COM 11.5-001).

The staff reviewed the applicant's Commitment (COM 11.5-001) to include provisions for sampling liquid and gaseous waste streams and batch liquid releases and found it acceptable. The staff designated Commitment (COM13.4-007), Commitment (COM 13.4-009), and Commitment (COM 13.4-010) as License Condition 11-2.

In FSAR Subsection 11.5.4.5, the applicant adds that the reactor water radioiodine concentrations will be maintained below the values in FSAR Table 12.2-206, in accordance with the ODCM. The staff noted that FSAR Table 12.2-205, not Table 12.2-206, provides the reactor water iodine radioisotope concentrations. After evaluating this change in SER Section 12.2.2, the staff issued RAI 12.02-7 asking the applicant to provide additional information on the proposed approach limiting reactor water iodine radioisotope concentrations, in accordance with the ODCM. The applicant's response to this RAI dated June 17, 2011 (ADAMS Accession No. ML11171A297), provides additional information and correctly references the radioiodine concentration limits in FSAR Table 12.2-205. The staff reviewed the proposed administrative control of radioiodine concentrations under the ODCM and found STD COL 11.5-2-A to be acceptable and in compliance with Sections II.A through II.C of Appendix I to 10 CFR Part 50.

- STD COL 11.5-3-A Process and Effluent Monitoring Program

This COL item addresses the development and implementation of a site-specific monitoring and sampling program described in the ODCM for Fermi 3. Section 13.4 of the Fermi 3 COL FSAR addresses the milestones for developing and implementing the radiological environmental monitoring program in Table 13.4-201 under Commitments COM 13.4-007 and 13.4 -009.

Subsection 11.5.4.6 of the Fermi 3 COL FSAR, Revision 0, on process and effluent monitoring and sampling presents information in Table 11.5-201 on sampling for several Fermi 3 plant systems, including the plant service water system (PSWS) (item 2), storm drains and cooling

tower blowdown (item 11), and sanitary wastewater (item 14). The staff reviewed the applicant's information on the Process and Effluent Monitoring Program listed in Table 12.5-201 and issued RAI 11.05-01, which noted internal data and footnote inconsistencies in Table 12.5-201 (in a comparison to DCD Table 11.5-5) on sampling for items 2, 11, and 14.

Under RAI 11.05-01, the staff asked the applicant to address the following observations:

- a. Plant Service Water System (PSWS) (line item 2). For this system, footnotes 6 and 8 of Table 11.5-201 clarify sampling provisions and each sampling stream that would be treated through the LWMS. However, a review of MFN 06-417 Supplement 4, dated October 29, 2007 (ADAMS Accession No. ML073050178), indicates that in response to DCD RAI 9.2-8 S02, footnote 8 was replaced with footnote 4 in DCD Revision 5; however, Table 11.5-201 in the Fermi 3 COL FSAR does not reflect that change. Accordingly, the staff asked the applicant to update FSAR Table 11.5-201, line item 2, for the PSWS, to include the proper footnote citations. This information would ensure that such provisions are clearly identified in the FSAR and are not likely to be omitted during the development of the sampling and analysis program for the plant-specific ODCM in confirming compliance with the liquid effluent concentration limits of Table 2 (column 2) in Appendix B to 10 CFR Part 20 and the design objectives in Appendix I to 10 CFR Part 50.

The applicant's response dated April 8, 2009 (ADAMS Accession No. ML091060496), modifies the entry in FSAR Table 11.5-201 for item 2 with the new title, "Service Water System and/or Circulating Water System." The response includes a new footnote 9 for item 2, which indicates that grab water samples can be obtained from the cooling tower basin (referring to FSAR Subsection 9.2.1.2 for the PSWS cooling tower basin and Subsection 10.4.5.2.3 for the circulating water system cooling tower basin). The staff reviewed this response and found it acceptable, with the inclusion of both the PSWS and the circulating water system and the new footnote 9 in item 2 of Table 11.5-201. Therefore, this portion of the RAI is resolved.

- b. Storm Drains and Cooling Tower Blowdown (line item 11). For these two systems, footnote 4 of Table 11.5-201 does not refer to specific sampling provisions, such as sampling points or installation of automatic composite samplers. FSAR Sections 9.2, 10.4, and 11.5 do not appear to make such provisions for either system. Accordingly, the staff asked the applicant to confirm whether this observation is correct and update FSAR Sections 9.2, 10.4, and 11.5 by providing specific references to DCD or FSAR sections that present this information or, if not, by supplementing the appropriate FSAR sections with additional design details. This information would ensure that such provisions are clearly identified in the FSAR and are not likely to be omitted during the development of the sampling and analysis program for the plant-specific ODCM in confirming compliance with the liquid effluent concentration limits of Table 2 in Appendix B to 10 CFR Part 20 and the numerical objectives in Appendix I to 10 CFR Part 50.

The applicant's response dated April 8, 2009, provides additional information and a revision to Table 11.5-201 item 11 by eliminating the cooling tower blowdown system from column 3 as an included ESBWR system. Furthermore, the applicant revised the footnotes by eliminating footnote 4 on general effluent monitoring and replacing it with a new footnote 10, which indicates that grab samples can be obtained from the condensate storage tank basin sump. The staff reviewed this response and found it

acceptable with the clarification of item 11 in Table 11.5-201, the elimination of footnote 4, and the inclusion of the new footnote 10. Therefore, this portion of the RAI is resolved.

- c. Sanitary Waste Water System (line item 14). Footnote 4 of Table 11.5-201 does not refer to specific sampling provisions for this system. Therefore, the staff asked the applicant to add a new footnote to the system's line item 14 (column 3 in Table 11.5-201) indicating that grab samples can be obtained from the sewage treatment plant for the purpose of detecting the presence of radioactivity. This information would ensure that such provisions are clearly identified in the FSAR and are not likely to be omitted during the development of the sampling and analysis program for the plant-specific ODCM in confirming compliance with the liquid effluent concentration limits of Table 2 in Appendix B to 10 CFR Part 20 and the numerical objectives of Appendix I to 10 CFR Part 50.

The applicant's response dated April 8, 2009, revises the ESBWR system description in Table 11.5-201, item 14, from the "Sanitary Waste Water System" to the "Sanitary Waste Discharge System." In addition, the applicant deleted footnote 3, on batch-wise liquid waste processing; footnote 4, on general effluent monitoring; and footnote 6, defining the application of the provisions to systems that are not monitored, sampled, or analyzed before release. A new footnote 11, which indicates that grab samples can be obtained from the sewage treatment plant, replaced these deleted footnotes. The staff reviewed this response and found it acceptable, with the clarification of the sanitary waste discharge system, deletion of the previously cited footnotes, and the inclusion of the new footnote 11. Therefore, this portion of the RAI is resolved.

The staff verified that the applicant has incorporated the changes noted above in the Fermi 3 COL FSAR, Revision 1. Therefore, RAI 11.05-01 is resolved. In addition, STD COL 11.5-3-A is acceptable because it meets the guidance in RGs 1.21, 1.33, 1.97, 1.206, 4.1, 4.15, and BTP 7-10 and complies with 10 CFR Part 20, and 10 CFR Part 50.

- STD COL 11.5-4-A Site-Specific Offsite Dose Calculation

This COL item addresses compliance with the design objectives in Appendix I to 10 CFR Part 50 of controlling doses to a hypothetical, maximally exposed member of the public and populations living near Fermi 3. In Subsection 11.5.4.8 of the Fermi 3 COL FSAR, the applicant states that the ODCM addresses the guidelines in Appendix I to 10 CFR Part 50 and FSAR Section 12.2.2 provides the site-specific doses to members of the public. The staff's evaluation under COL Item STD COL 11.5-2-A provides further discussion on the ODCM, which is in compliance with Sections II.A through II.C of Appendix I to 10 CFR Part 50. The staff finds that the applicant's response adequately addresses this COL item and is therefore acceptable.

- STD COL 11.5-5-A Instrumentation Sensitivities

In Subsection 11.5.4.9 of the Fermi 3 COL FSAR, the applicant states that the ODCM will describe the instrument sensitivities, sampling, and analytical frequencies and the basis for each gaseous and liquid sample. The applicant references FSAR Subsection 11.5.4.5 for a discussion on the development and implementation of the ODCM. The staff's evaluation under COL Item STD COL 11.5-2-A provides further discussion on the ODCM (in terms of compliance with the guidance in RGs 1.21, 1.33, 1.97, 4.1, 4.15, and BTP 7-10 and complies with 10 CFR

Part 20, 10 CFR Part 50). The staff finds that the applicant's response adequately addresses STD COL 11.5-5-A and is therefore acceptable.

#### **11.5.5 Post Combined License Activities**

For the reasons discussed in the technical evaluation section above, the staff has identified the following license condition:

- License Condition (11-2) - At least 180 days before the date scheduled for initial fuel load as set forth in the notification submitted in accordance with 10 CFR 52.103(a), DTE Electric Company shall implement an operational program for process and effluent monitoring and sampling, including the following subprograms and documents:
  - a. Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls (COM 13.4-007)
  - b. Offsite Dose Calculation Manual (COM 13.4-009)
  - c. Radiological Environmental Monitoring Program (COM 13.4-010)

No later than 12 months after issuance of the COL, the licensee shall submit to the Director of the NRO a schedule that supports planning and conducting NRC inspections of the operational program for process and effluent monitoring and sampling (including Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls, the Offsite Dose Calculation Manual, and the Radiological Environmental Monitoring Program). The schedule shall be updated every 6 months until 12 months before scheduled fuel loading and every month thereafter, until the above operational program has been fully implemented.

#### **11.5.6 Conclusion**

The NRC staff's finding related to information incorporated by reference is in NUREG-1966. NRC staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant addressed the required information related to the PRMS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the PRMS that were incorporated by reference are resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 11.5, NRC RGs, and industry standards. The staff's review concludes that the applicant presented adequate information in the Fermi 3 COL FSAR to meet the requirements of the PRMS, which includes the equipment necessary to monitor process and effluent streams; describes an operational program to control releases of radioactive materials associated with the operation of the LWMS, GWMS, and SWMS; and incorporates provisions to implement a sampling and monitoring program. Furthermore, the staff concludes that the PRMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance of RGs 1.109 and 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- The PRMS includes the instrumentation for monitoring and sampling radioactivity in contaminated liquid and gaseous process and effluent streams and in solid wastes

during routine operations, AOOs, and accident conditions. The staff evaluated the proposed provisions for sampling and monitoring appropriate process streams and effluent release points, including nonradioactive systems that could become contaminated through interfaces with radioactive systems.

- The applicant's proposed development of the ODCM for Fermi 3, as it relates to controlling and monitoring effluent releases and doses to members of the public, meets the requirements of Appendix I to 10 CFR Part 50; 10 CFR 20.1301(e); and 10 CFR 20.1302. Therefore, the staff concludes that the endorsement of NEI 07-09A, Revision 0, and the PRMS supplemental information in FSAR Section 11.5 are consistent with GL 89-01.